Abstract of the Disclosure

The position, orientation, velocity and acceleration of remote sensors is determined using magnetic fields. Multiple, arbitrarily oriented magnetic field transmitters are placed in one reference frame (source reference frame), and multiple, arbitrarily oriented magnetic field receivers are placed in a second reference frame (body reference frame). The spatially varying magnetic fields of the transmitters in the source reference frame are sensed by the magnetic field receivers in the body reference frame. The computer algorithm uses a physics-based extended Kalman filter to resolve the position, orientation, velocity and acceleration of the body relative to the source reference frame. The physics-based extended Kalman filter can accommodate the effects of metal in the source and body reference frames and thus allow the system to measure position, orientation, velocity and acceleration under conditions where eddy currents would normally hinder other magnetic position measuring systems. The Kalman filter also allows the use of multiple transmitters and receivers distributed over an arbitrarily large sensing volume, thereby extending the useful range and accuracy of the system. Further, the Kalman filter allows the use of high-speed measurements with minimal signal averaging, thus extending the useful dynamic response of the system. Moreover, the Kalman filter allows the use of arbitrarily oriented transmitters and receivers, thus increasing the flexibility of the system in many applications.